No. 658,366.

Patented Sept. 25, 1900.

C. G. HASTINGS.

TUNNELING SHIELD.

(Application filed Nov. 8, 1899.)

(No Model.)

4 Sheets—Sheet 1.

Fig. 6

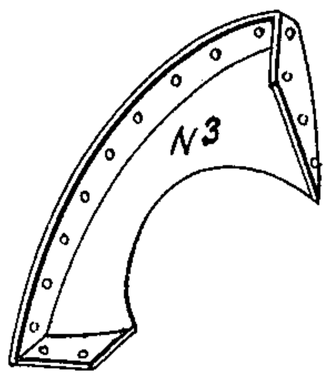


Fig. 7

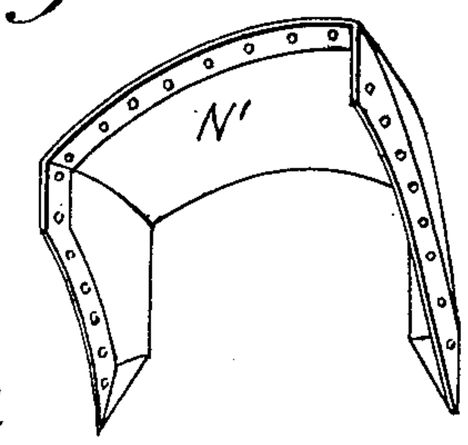
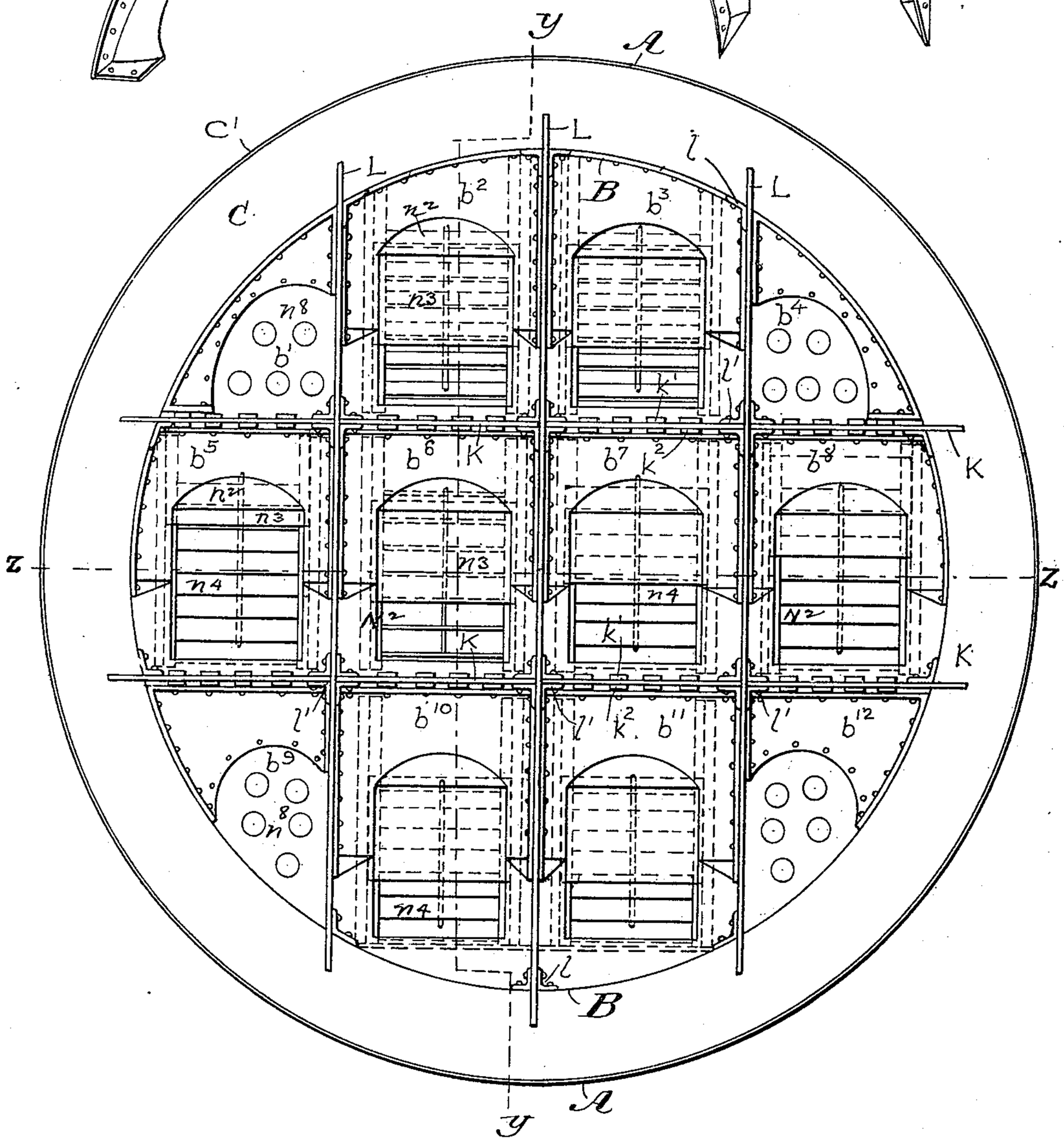


Fig. 1



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(No Model.) 4 Sheets—Sheet 2.

Fig. 2

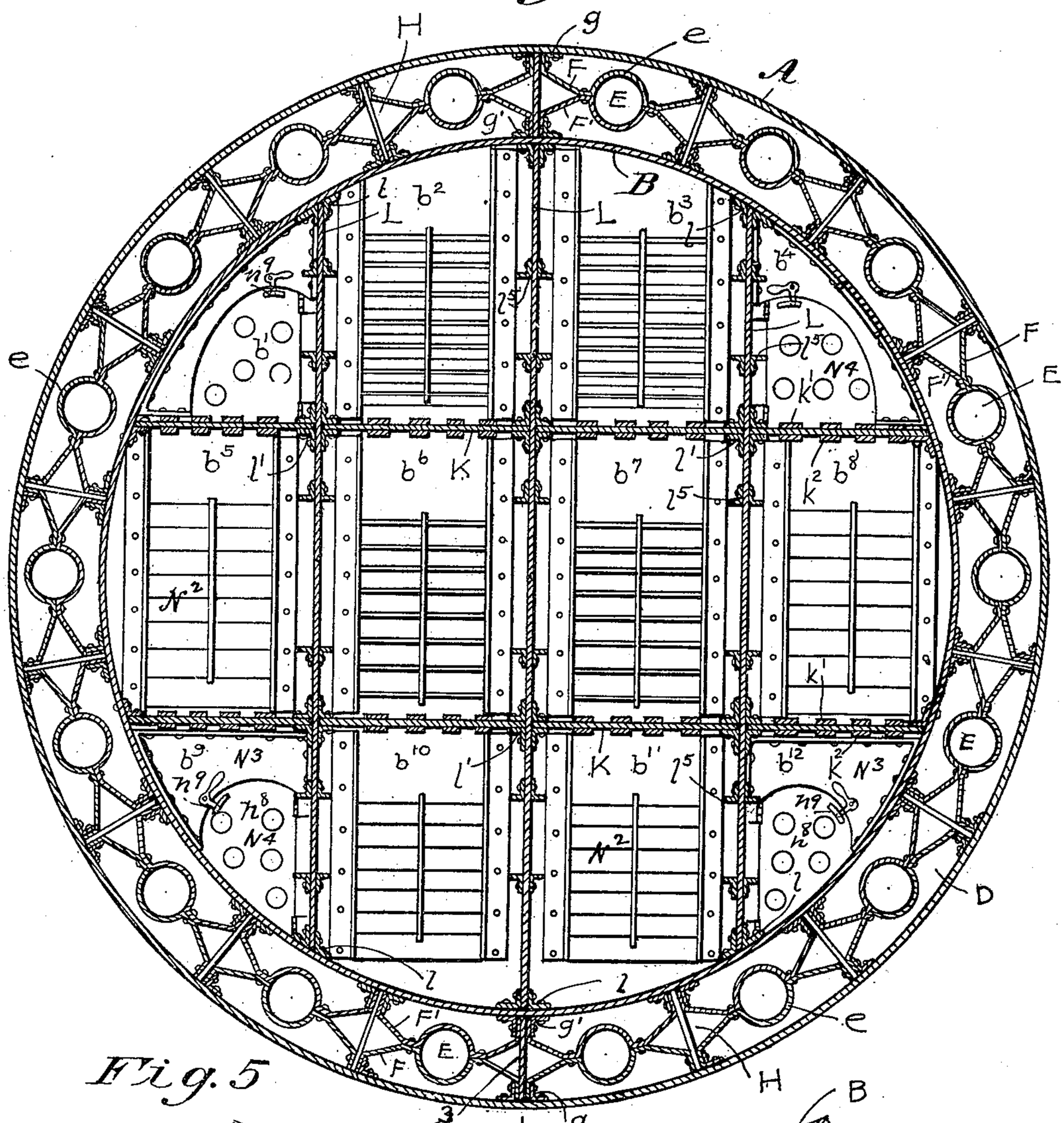

Fig. 5

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(No Model.) 4 Sheets—Sheet 3.

Fig. 3

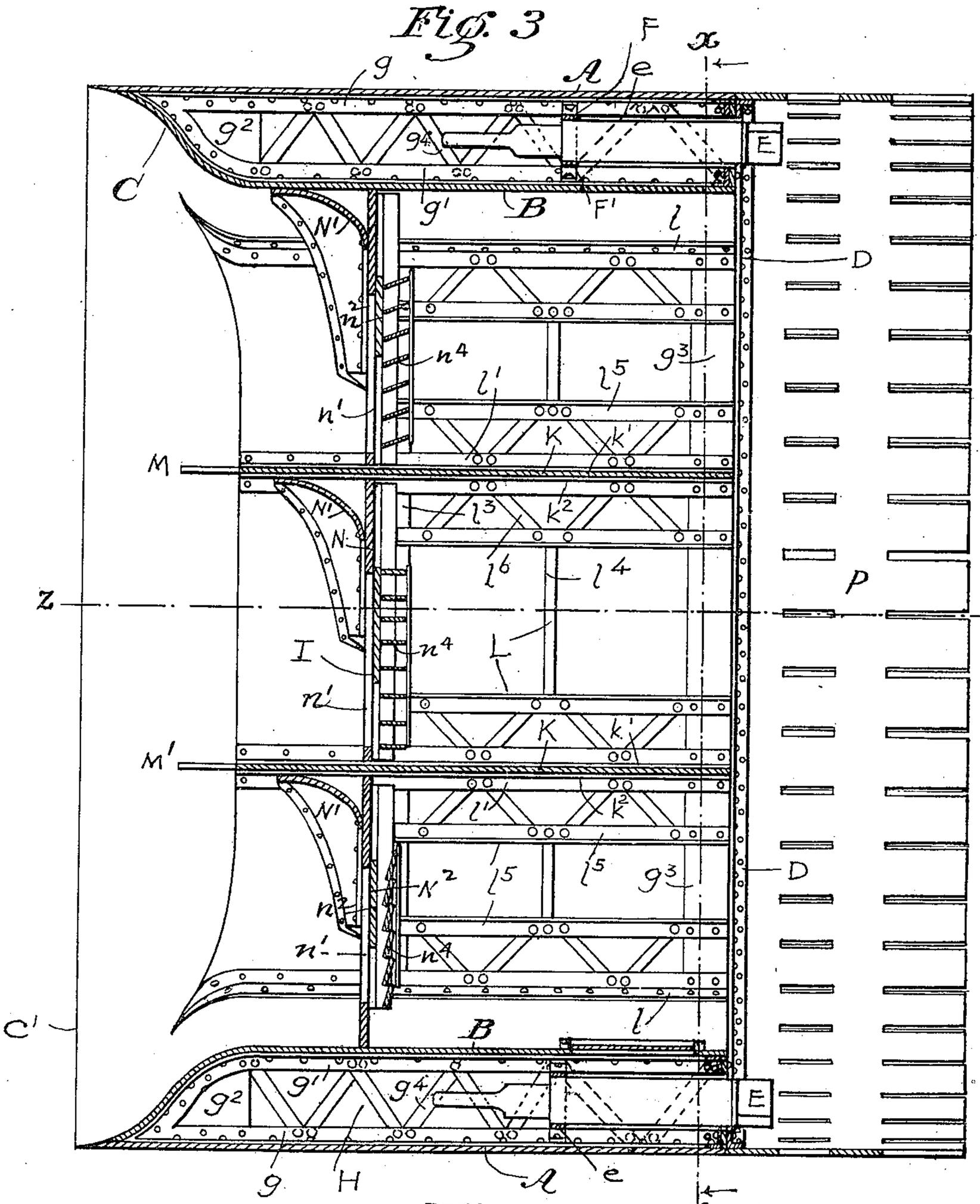
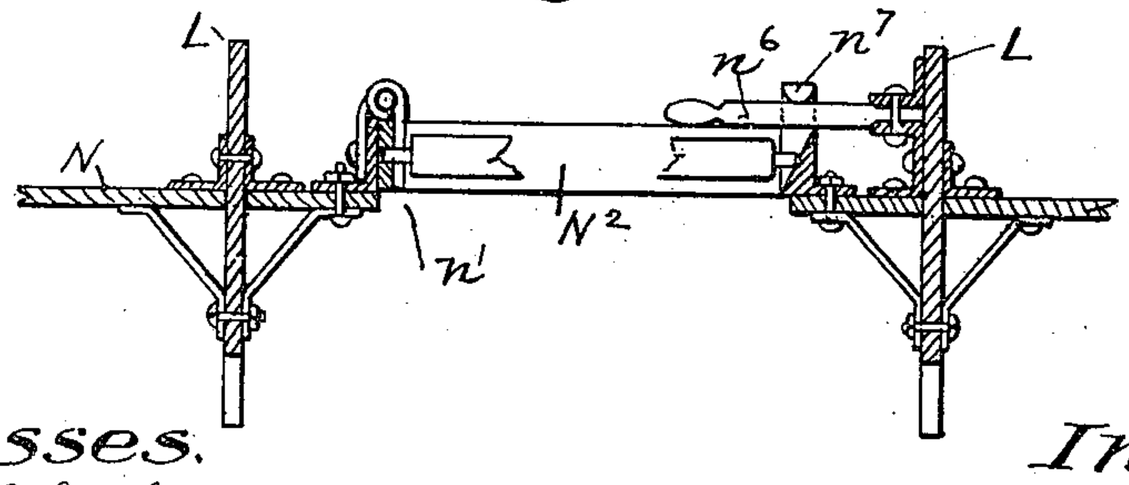


Fig. 8



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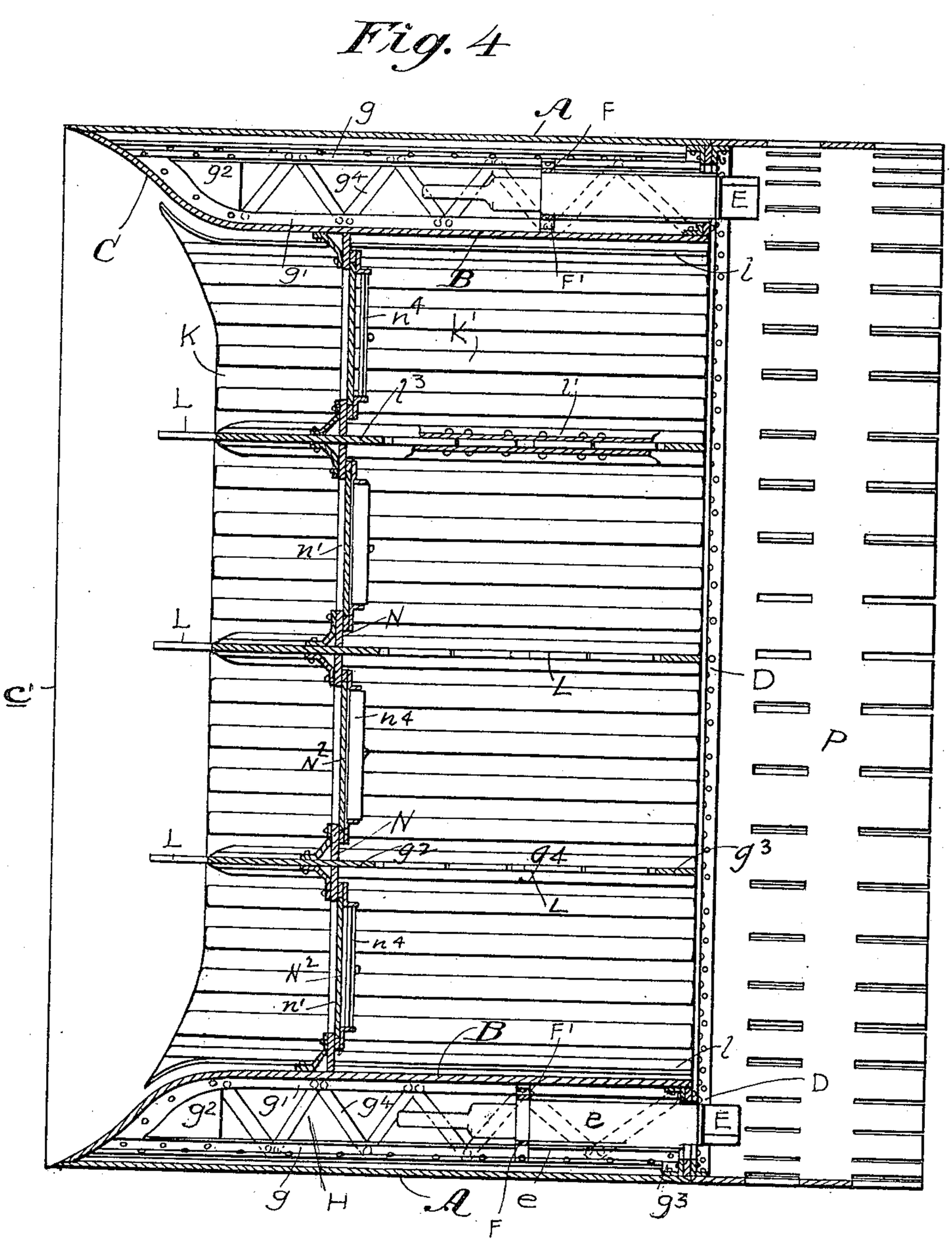
(No Model.)

4 Sheets—Sheet 4.

Fig. 4



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UNITED STATES PATENT OFFICE.

CORNELIUS G. HASTINGS, OF CHICAGO, ILLINOIS.

TUNNELING-SHIELD.

SPECIFICATION forming part of Letters Patent No. 658,366, dated September 25, 1900.

Application filed November 8, 1899. Serial No. 736,266. (No model.)

To all whom it may concern:

Be it known that I, CORNELIUS G. HASTINGS, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Tunneling-Shields, of which the following is a specification.

My invention relates to certain improvements in tunneling-shields which are employed for excavating tunnels, subways, and conduits, some of said improvements pertaining especially to shields of the type for which a patent has been granted to me, wherein a double cylinder is employed, the front of which is provided with a cutting-face, the rear portion of the double cylinder inclosing a plurality of hydraulic rams, by means of which the shield is pushed forward and the soft or compressible material, such as sand or gravel and silt, is compressed from the line of the outer cylinder to the interior of the inner cylinder, in which a flexible hood is employed at the rear end of the cylinder to admit of the deflection of the cylinder from its axial line and which also employs a bulkhead and hooded doors having deflectors of novel construction.

My invention consists, first, in various novel details of construction to provide lighter and stronger trussed division-plates between the two cylinders and also between the several floors of the inner cylinder, which will provide numerous open spaces within the cylinder-shells for convenient access to the hydraulic rams and their fittings inclosed between the said shells; in providing trusses and intermediate spaces in the division-walls to admit of passing from one chamber to the other within the inner cylinder, and in providing certain novel hooded and adjustable sections and adjacent longitudinal division cutting-plates and provide a sectional bulkhead and numerous cells in advance of the bulkhead which will admit of either the partial or complete closure of any part or the entire area of the said bulkhead and the separate compression of the earth passing through the said separate cells at the forward end of the shield, thus completely protecting the interior of the shield against the excessive inflow of the soft sand, earth, or liquid material at any part or at all parts of the face of the shield.

My invention also provides an improved flexible hood comprising a reticulated and slotted cylinder which will retain its integrity under excessive pressure without materially affecting its flexibility, and also provide certain details of construction and combination of parts for the furtherance of the above-named and other objects of my invention, which will hereinafter appear in the accompanying drawings, which will serve to illustrate my invention.

Figure 1 is a front elevation of my improved tunneling-shield; Fig. 2, a vertical section in line *x x* of Fig. 3; Fig. 3, a vertical longitudinal section in line *y y* of Fig. 1; Fig. 4, a horizontal section in line *z z* of Fig. 1; Fig., 5 an enlarged detail in elevation of the yokes for supporting the hydraulic jacks; Fig. 6, a perspective view of the deflectors for the cutting division-plates of the triangular chambers within the cutting-face of the shield; Fig. 7, a perspective view of the deflectors for the quadrangular chambers within the said cutting-face, and Fig. 8 an enlarged horizontal sectional detail of the hinged and slotted door connected with the bulkhead.

The outer cylinder A and inner cylinder B are connected at their forward ends to an inwardly-dished cutting-section C of ogee cross-section and at their rear ends to a series of perforated segment-plates D, through which the rear ends of the hydraulic rams E pass and are secured, the large cylinders *e* of said rams being held between yokes F F′, supported in a novel manner, as will hereinafter appear, between the radial trusses H, which connect the outer and inner cylinders. Longitudinal angle-irons *g g′* upon the inner sides of the outer and inner cylinders, respectively, extend from the segment-plates D to the extreme forward point or cutting edge *c′* of the cutting-section *c*, the forward ends being connected by a radial plate g^2, the rear ends by a radial plate g^3, and the intermediate portion by truss-bars g^4, connected diagonally to each other. The yokes F F′, bolted together, as shown in Fig. 2, may have journals *f* on the ends thereof, which are supported in bearings *f′* in bracket-plates

g^5, bolted at right angles to the angle-irons g g', as shown in Fig. 5, by which means the said yokes may be turned thereon out of the way to give access to the space between the outer and inner cylinders when the rams and their connections are to be repaired or handled.

The several longitudinal chambers b' b^2 b^3, &c., extend from the bulkhead I to the rear end of the shield-cylinders and are separated by horizontal sheet-metal floor-plates K, each having longitudinal strips or slats k' k^2 secured to the opposite sides thereof, which reinforce and stiffen the floor-plates while the minimum thickness of metal is employed. The floors are suspended and stayed by vertical truss division-walls L, which are placed at equal distance from each other and extend from the top to the bottom of the inner cylinder, thus dividing the space into two central quadrangular chambers b^6 b^7, four approximately triangular chambers b' b^4 b^9 b^{12}, and six quadrangular chambers b^2 b^3 b^5 b^8 b^{10} b^{11}, extending from the top outer sides and bottom of the central chambers, the truss division-walls being constructed in a novel manner to afford direct and convenient access from one to the other of all the chambers upon the same floor through which material may be passed, the trusses providing sufficient rigidity and strength to uphold the floors without adding unnecessary weight to the shield, great strength and lightness being essential to secure the best results where large shields are employed.

The truss division-walls are composed of angle-irons l, secured to the inner shell, angle-irons l', secured to the floor-plates, vertical end plates l^3, and radial plates g^3, connected by intermediate longitudinal bars l^5, and the latter are connected, respectively, with the adjacent angle-irons l l' by truss-bars 1^6, extending in diagonal or zigzag lines from the bulkhead I to the rear end of the shield. The space between the two intermediate longitudinal bars l^5 is sufficient to allow of free passage for men or material from one longitudinal chamber to another, and, when needed, a vertical tie-plate l^4 may connect the middle part of the longitudinal bars.

The forward end of the shield-cylinders is fitted with vertical and horizontal cutting-plates M M', secured in the same planes with the truss division-walls L and the floors K of the longitudinal working-chambers. The horizontal cutting-plates N' have longitudinal strips k' continuous with the strips of the floor-plates, and are thereby strengthened to resist the tendency to buckle. The forward points of the said vertical and horizontal cutting-plates have points m m', which project beyond the straight edge of the said plates to make contact with the rounded shoulders of the cutting-face c' of the shield-cylinders, thus adapting the said plates to more easily penetrate the earth as a plow-point. The cutting-plates are integral with the end plates l^3 of the division-walls L, a removable bulkhead N being held thereto between each cutting-section c' and working-chambers b' b^2, &c., of the shield. A door-opening n' is provided in said bulkhead and a cone-shaped deflecting-plate N' is fitted to the cutting-plates M M' and the bulkhead at the door-openings, which serve to direct the earth within each cell-section to the door-opening thereof, and where loose and soft ground is worked will hold back the flow of earth to the interior and working chambers of the shield until it can be properly handled and disposed of. The quadrangular bulkhead-sections have door-openings n and have doors N^2 hinged to the bulkhead-sections and preferably made in detachable or movable parts or panels n^2 n^3 to slide, as shown in Figs. 1 and 3, the said doors being also fitted, when desired, with pivoted slats n^4, connected by a vertical strip n^5, which will serve to move and hold the said slats in an open, partly open, or closed position to allow only a predetermined quantity of earth or earthy material to pass through the door-openings from the forward end or cutting-cells of the shield into the working-chambers. The doors N^2 may be constructed in detail, as shown in Fig. 8, and is secured when closed by a pivoted hand-bar n^6, which engages with a jaw n^7 on the inner side and swinging end of the door. The triangular bulkhead-sections have perforated sheet-metal plates n^8 bolted to the inner shell of the cylinder and to the cutting-plates at the forward end of the shield, and cone-shaped deflecting-plates N^3 are secured to the outer face thereof to compress and direct the loose earth to the said perforations, a door N^4 being fitted upon the inner face of the bulkhead-plates n^8 and secured when closed by notches n^9, the said doors being opened when required to remove the earth from the triangular cutting-cell in the face of the shield.

The tailpiece or hood P at the rear end of the shield is made in the shield as now designed of a sheet or sheets of steel having parallel slots extending longitudinally thereof with intervening connecting portions which link the strips together and maintain them in parallel position at a uniform distance apart, as it has been found that disconnected strips held together at one end only when subject to great pressure are liable to bend unequally and yield too easily to the pressure of the earth upon them.

The shield constructed as herein described and claimed is well adapted to heavy work, and when only a part of the earth is loose and unmanageable the bulkhead-sections opposite such portions only of the heading may be employed. When the ground is firm and hard, the bulkhead-sections may be removed all together.

I claim as my invention and desire to secure by Letters Patent—

1. A tunneling-shield comprising a cutting-

face at the forward end a hood at the rear end two concentric cylindrical shells extending from and connecting said outer face and hood and longitudinal trusses connecting the said cylindrical shells providing open partitions and a plurality of compartments for hydraulic rams to be held therein substantially as described.

2. A tunneling-shield comprising a cylindrical shell vertical and horizontal cutting and division plates at the forward end rearwardly-extending floor-plates and trussed partitions comprising longitudinal parallel bars and connecting-plates and providing intermediate spaces between the said bars substantially as described.

3. A tunneling-shield comprising a cutting-face at the forward end a hood at the rear end two concentric cylindrical shells extending from the cutting-face to the hood a series of radial trusses interposed between and connecting said cylindrical shells perforated segment-plates connecting the rear ends of the inner and outer cylinders hydraulic rams supported between said radial trusses and projecting through the perforations of the segment-plates and separable yoke-sections for supporting the forward ends of the rams substantially as described.

4. A tunneling-shield comprising a cylindrical shell vertical and horizontal cutting and division plates at the forward end thereof floor-plates extending rearwardly from the horizontal cutting and division plates and reinforcing-strips secured longitudinally to the said cutting and division plates and floor-plates substantially as described.

5. A tunneling-shield comprising a cylindrical shell vertical and horizontal cutting and division plates at the forward end thereof to provide cellular sections removable bulkheads adapted to each of said cellular sections and doors adapted to said removable bulkheads substantially as described.

6. A tunneling-shield comprising a cylindrical shell vertical and horizontal cutting and division plates at the forward end thereof to provide cellular sections, bulkheads adapted to said sections and a door having slatted panels fitted upon said bulkhead, substantially as described.

7. A tunneling-shield comprising a cylindrical shell vertical and horizontal cutting and division plates at the forward end thereof to provide quadrangular sections, bulkheads adapted to said sections fitted with doors and fixed hooded triangular sections having fixed perforated bulkheads the said quadrangular and triangular chambers filling the cutting-face of the cylindrical shell substantially as described.

8. A tunneling-shield comprising a cutting-face at the forward end, a cylindrical shell, and a hood at the rear end thereof consisting of a plate having a series of slits by which said plate is divided in parallel strips being left united through a portion of their length, whereby said strips are hinged together and also maintained parallel and at a uniform distance apart, substantially as described.

9. A tunneling-shield comprising a cylindrical shell, vertical and horizontal cutting and division plates at the forward end thereof to provide cellular sections, an apertured bulkhead at the rear of said cutting and division plates and arched deflector-plates encircling the top and sides of the upper ends of said apertures and connecting both the vertical and horizontal division-plates with the bulkhead substantially as described.

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